Activity 4:

Using Your Map for Analysis – Lava Hazard Zones

When a volcano erupts, how much time do residents have to evacuate? That depends. Lava flows downhill and travels faster over steep ground. In the early 1990s, residents of Kalapana, a town in the southeastern Puna region, had days or even weeks to prepare for a lava flow that eventually covered the town. By contrast, a 1950 lava flow down the western flank of Mauna Loa reached the sea in about four hours. Although scientists monitor ground movement on the island continuously, there is no way to know how much advance notice residents living downhill of an eruption will receive.

In this activity, you'll explore the relationships among lava flow zones, emergency shelters, and population.

Configure the Map

1. Open your **Hawaii Island Emergency Shelters** map. You need to click on the My Content tab to find it. Then click the map thumbnail to open it or use the Open menu beneath the thumbnail.

2. On the ribbon bar, click the Add button and choose Search for Layers. Click the drop-down box next to In and choose ArcGIS Online.

    In the Find box, type Hawaii census 2010. In the list of results, locate **HawaiiCensusBlocks2010** by Learn_ArcGIS. Click Add to add the layer to the map.   At the bottom of the Search for Layers pane, click the DONE ADDING LAYERS button.

3. Change the basemap to **Streets**.

4. In the Contents pane, do the following (hint: you learned how to do these in the previous activities):

    - Turn off the Terrain and Highways layers
    - Rename the HawaiiCensusBlocks2010 layer to Census Blocks
    - Move the Census Blocks layer so that it is beneath the Lava Flow Hazard Zones.

    Note: Census blocks symbolize population density (people per square mile) in shades of gray.

5. Right now, the pop-up box for the Lava Flow Hazard Zones layer is configured to display the region name, but it would be more useful in this analysis for it to display the lava flow hazard <u>severity</u>. To change this, hover over the Lava Flow Hazards Zone in the Contents pane, click on More Options, and then Configure Pop-up.

    Under Pop-up Title, delete {REGION} from the box. Then click the add field name button to the right of the box (the small plus symbol) and choose SEVERITY.

    Click the save pop-up button. Now, when you click on a lava hazard zone on the map, it will display the severity of the hazard in that region.

6. On the ribbon above the map, type Hilo into the Find address or place box, and hit enter. The map will zoom to the island's east coast.

    Hilo is the island's largest town, and most of the population lives in or near it. At this scale, the census blocks are easier to see under the hazard zone.

7. Click anywhere in the red lava flow hazard zone to see its pop-up. If a pop-up for a different layer opens, use the arrow in the pop-up title bar until it appears.

    Notice that Hilo lies in a high hazard zone. Zoom out. What about the populated areas to the south of Hilo? **What kind of hazard do those communities face?**

8. Open pop-ups for the other lava flow hazard zones in the area.

9. Use bookmarks to explore the other parts of the island. When you're finished, zoom to the Hawaii Island bookmark.

10. Click on the drop-down arrow next to the Save button on the ribbon bar above the map and select **Save As**. Save your map as **Hawaii Island Emergency Shelter Access Analysis**.

Analyze shelter accessibility

Many people, on different parts of the island, live in high-hazard lava flow zones. Usually, there are a good number of emergency shelters in these areas. But how accessible are these shelters? And how should accessibility be measured? Which high-risk parts of the island may need additional shelters? In this section, you'll use analysis tools to evaluate shelter access on the island of Hawaii.

In this section, you'll analyze accessibility by creating drive-time areas around the emergency shelters. Drive-time analysis uses either distance or expected travel time along a street network to show the area within reach of a given location or set of locations. You'll use a drive-time value of 15 minutes to define a shelter as easily accessible. This number was chosen somewhat arbitrarily, and you might want to repeat the analysis later with other values to see how the results change.
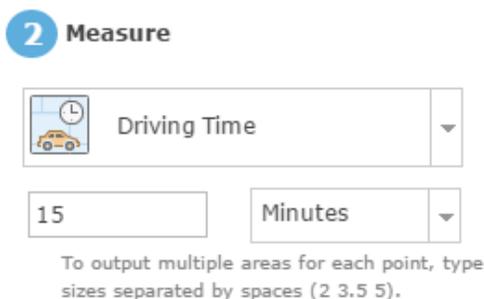
This analysis does not attempt to model emergency conditions. In a real emergency, all sorts of things may happen. Evacuation routes may be cut off by lava flow, roads may be jammed, emergency shelters themselves may lie in the lava flow path, and so on. Nonetheless, the ability to see which areas of the island have easy access to a shelter, and which do not, is a useful planning aid.

Create the drive-time layer

1. In the Contents pane on the left-hand side, hover over the Emergency Shelters layer and click the Perform Analysis button.

2. In the Perform Analysis pane, click Use Proximity, and then click Create Drive-Time Areas.

3. On the Create Drive-Time Areas pane, under Measure, confirm that Driving Time is the selected option. Change the time to 15 Minutes.

Leave the Use traffic box unchecked. With the box unchecked, the analysis assumes that traffic flow is unimpeded and motorists observe the speed limit.

In a real emergency, why might this not be the case?

4. Under Areas from different points, click Dissolve.
The default Overlap option creates a unique drive-time area for each shelter. Dissolving the areas creates one output feature instead of many. The same total area will be covered.

5. Give the result layer a name that will be unique in the organization. This will prevent your analysis result layer from conflicting with somebody else's in our organization.

6. Click Run Analysis. When the analysis is finished, a new layer is added to the map. It shows the areas on the island that are within a 15-minute drive of a shelter.

7. On the Contents pane, hover over the Shelter in 15 Minutes by Your Name layer, more options button, and choose Rename.

8. In the Rename dialog box, change the layer name to **Area within 15 Minutes of Shelter** and click OK.

9. Move the Area within 15 Minutes of Shelter down, so that it is below the census block layer in the Contents pane.

10. Save your map.
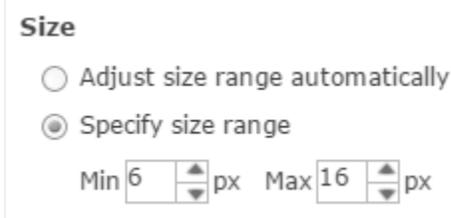

Change symbols for the Census Blocks layer

You want to compare the area within 15 minutes of a shelter to populated areas of the island, but the map symbology makes that difficult. It will help to turn off the Lava Flow Hazard Zones layer. You can also change the way the census blocks are represented. Although the blocks are areas, it will be easier to see how well they're covered by the drive-time layer if you display them as points. (Essentially, you'll represent each block by its central point.)

11. On the Contents pane, uncheck the box next to the Lava Flow Hazard Zones layer. Now it's easier to see the census blocks.

12. On the Contents pane, click on the Census Blocks layer name to expand its symbology.
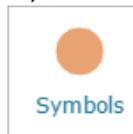

Census blocks drawn in lighter shades of gray are less densely populated. High-density blocks are shown in darker shades of gray.
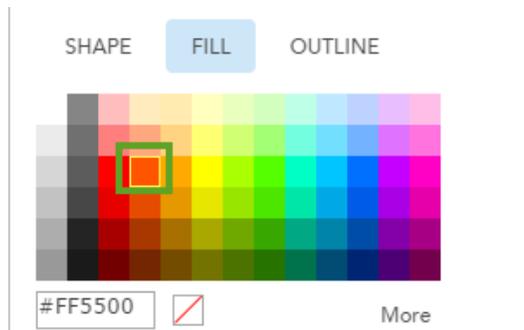
13. Hover over the Census Blocks layer and click the Change Style button.
    On the Change Style pane, under option 1, the attribute being symbolized is 2010 Population. Because this attribute has been normalized by area, the values shown on the map reflect the population <u>density</u>, not the <u>total count</u>, within each census block. We need to change this.

14. Under option 2, click on the Counts and Amounts (Size) box to select it, then click the Options button.

15. Under size, select Specify size range, then change the Min size to **6** px (pixels). Change the Max size to **16** px.

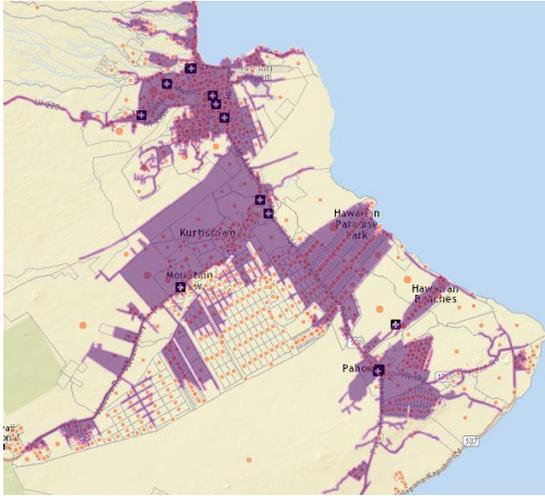16. For Color, click the Symbols button to open the color palette.

17. Choose the Fill option and click an orange-red color as shown below to change the fill color of the symbol.

18. Set the symbol transparency to approximately 40%.

19. Click OK and then Done to finish changing the symbol.
    On the map, the population of each census block is drawn as an orange circle. You don't see the census block boundaries anymore. Instead, the graduated circles give you a sense of how population is distributed on the island.

Zoom to the eastern portion of Hawaii so that you can see Hilo, Kurtistown, and Pahoa at the same time.

This way of drawing the census blocks gives a strong visual impression of where people can and can't reach a shelter within 15 minutes.

Compare Hilo to the region south of Kurtistown and Mountain view. Which has the higher population? Which has a larger percentage of residents not within 15 minutes of a shelter?
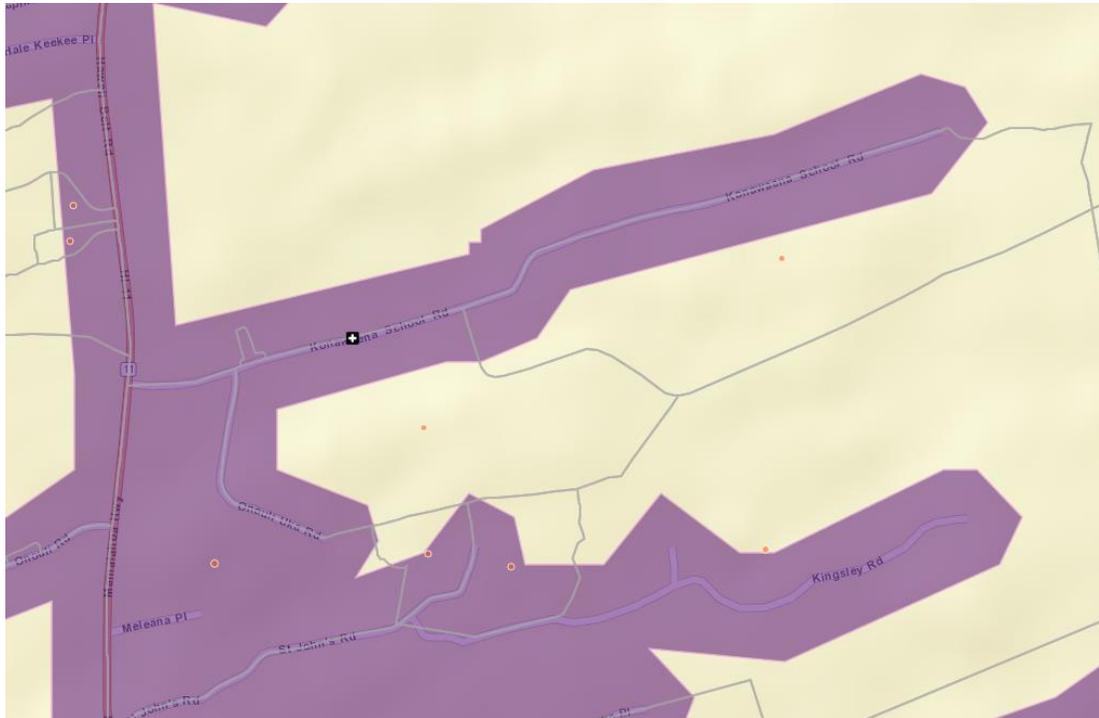
20. Zoom to the Hawaii Island bookmark and save the map.
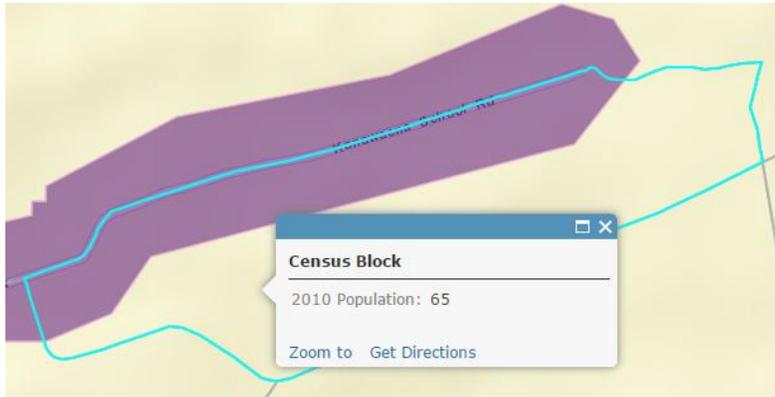
Interpret your results

In the previous section, you analyzed the physical side of lava flow risk. But what about the demographic side? The landscape and demographics of Hawaii are unique. Your map gives a good general impression of where people live and how accessible emergency shelters are, but you'll learn more from closer examination. Urban and rural locations on the island are close together. Population distribution is uneven and, in many places, infrastructure is simple. (For example, there are many unpaved roads.) Changing basemaps to look at both streets and imagery will give you a better understanding of the relationship among population, shelters, and the drive-time area.

You'll begin by exploring the southern part of the Kona Coast, around the town of Captain Cook, on the west side of the island.

1. In the search bar, type Captain Cook, Hawaii and hit enter.

2. Clear the pop-up, then zoom in approximately two levels near the shelter at Konawaena High School.

3. Click on a census block that lies, in part, outside the 15 minute drive-time area. When you click within the census block, the polygon is highlighted.

In this example, part of the block lies inside the drive-time area and part lies outside. Although you know that 65 people live within the block, you don't know exactly where they live. Some, none, or all of them may live within fifteen minutes of the nearby shelter.

4. On the ribbon above the map, click the Basemap button and choose Imagery.

5. Now, click the same census block as before. You should be able to see where the buildings and houses are located within the census block now. You can zoom in for a closer look, and don't forget, you can change the transparency of the 15 minute drive-time layer to make it easier to see through (75% seems to work well).

   Does it appear that most of the houses in this census block are within a 15 minute drive of an emergency shelter?

6. Zoom out slightly and pan around the map to examine other census blocks in the area. Many of the blocks are large and lightly populated. Judging by the locations of structures, it looks like most of the people in this area do live with the 15-minute drive-time area.

7. Change the Basemap back to Streets.

Let's compare the area you just examined to another part of the island. The Kau region, in the south and southeastern parts of the island, is rural, remote, and sparsely populated.

8. In the search bar, type Hawaiian Ocean View and hit enter.

   Do you see anything to indicate that the residents of the Hawaiian Ocean View subdivision live within a 15 minute drive of a shelter?

Maybe these residents live in a low hazard risk zone, and that is why there are no nearby shelters.

9. Turn the Lava Flow Hazard Zones layer on and click on the Hawaiian Ocean View subdivision.

    Which lava flow hazard zones do the residents of this subdivision live in?

10. Turn off the Lava Flow Hazard Zones layer. Change the Basemap to Imagery.

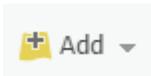   **Does it appear that there have been lava flows here in the past?**

    As it turns out, this neighborhood is adjacent to the Mauna Loa Rift Zone, an extremely high-hazard zone. This is a place where it might be useful to locate a shelter.

11. Change the Basemap back to Streets, and zoom out so that you can see the whole subdivision when you are done exploring this area.

Find the population of the Hawaiian Ocean View subdivision

It would be interesting to know how many people live in this remote subdivision—and it might strengthen the argument that an emergency shelter should be located nearby. To get the population, you can interactively draw a boundary around the subdivision, and then summarize the population inside.

1. On the ribbon above the map, click the Add drop-down arrow and choose Add Map Notes. (Map notes are features and text that you add to a map interactively.)

2. In the Add Map Notes dialog box, change the name to **Hawaiian Ocean View**, and click Create.
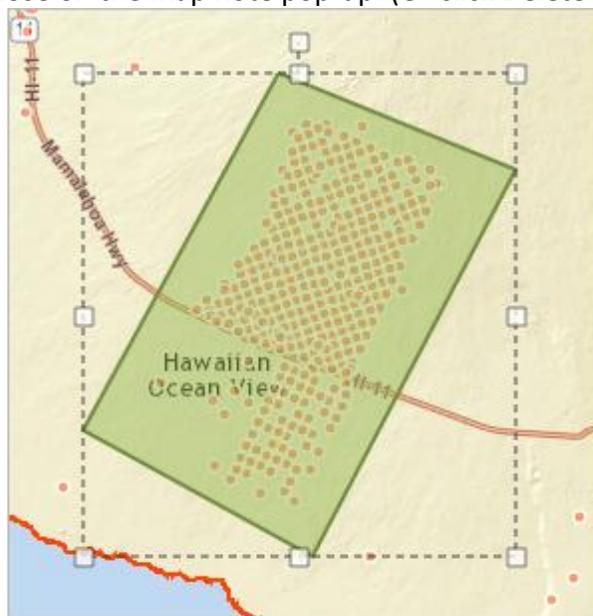
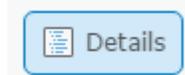3. In the Add Features panel, click the Area symbol.

4. Click the map somewhere outside the cluster of census block points to begin drawing a polygon. Move the cursor to start drawing the boundary, and click again when you want to add a corner or change direction.

    Continue drawing until you have a polygon that surrounds the subdivision. When you're done, double-click to finish the feature.

    Click Close on the map note pop-up. (Or click Delete if you need to start over.)

5. On the ribbon above the map, click the Details button to stop adding map notes. Note: you can click the Edit button if you need to go back and edit your map note.

6. Hover over the Hawaiian Ocean View layer and click the Perform Analysis button.

7. On the Perform Analysis panel, click Summarize Data and then click Summarize Within.

8. On the Summarize Within panel, under Step 1, make sure **Hawaiian Ocean View_Areas** is selected.

9. Under Step 2, select **Census Blocks** as the layer you want to summarize.

10. Under Step 3, choose **2010 Population** as the field and choose **Sum** as the statistic.
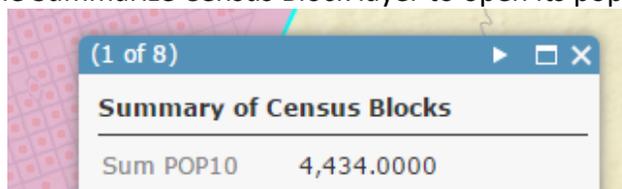
    This will result in a layer with the same shape as the Hawaiian Ocean View layer but with a total population value for the census blocks inside the polygon boundary.

11. **Uncheck** the Sum Area box. (You're not interested in the size of the subdivision.)

12. Do nothing under step 4.

13. Make the result layer name unique by adding your name at the end of the box in step 5, and finally, click the Run Analysis button.

    Be patient, the analysis may take a minute!

    When the analysis has finished, the new layer appears in the Contents panel under the Hawaiian Ocean View layer. (Layers created from map notes always stay at the top of the list.)

14. Turn off the Hawaiian Ocean View layer so that you can see the results of your analysis.

15. Click the Summarize Census Block layer to open its pop-up.

    Sum POP10 = the sum of the population of the selected census blocks as of the 2010 census.

    Note: Depending on how you drew your polygon, your population value may vary slightly.

16. Turn off the Summarize Population layer, zoom back out to the Hawaii Island bookmark, and save the map.